DERWENT-ACC-NO: 1983-52187K

DERWENT-WEEK: 198322

TITLE: Thermal conversion system - where caking of feedstock is obviated and impurity removal is enhanced

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PRIORITY-DATA: 1981GB-0029853 (October 2, 1981)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
GB 2109400 A	June 2, 1983	N/A	004	N/A
GB 2109400 B	August 14, 1985	N/A	000	N/A

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
GB 2109400A	N/A	1981GB-0029853	October 2, 1981

INT-CL (IPC): C10J003/00

ABSTRACTED-PUB-NO: GB 2109400A

BASIC-ABSTRACT:

A thermal conversion system has first and second reactors. The first pre-treats a feedstock by pyrolysis at atmospheric pressure from which a char and a liq. prod. are produced. The char is pulverised and then slurried with the liq. prod. prior to feeding to the second reactor.

Pref. the first and second reactors are of the cross-flow pyrolysis and the high pressure gasification type respectively. Also there is a methanol loop receiving gas from the second reactor and a liquor cycle in which the gaseous prod. from the first reactor is treated and mixed with water to produce the liq. product. Undesirable characteristics such as caking of the feedstock is obviated in the pretreatment pyrolysis. Also impurities such as mineral matter and metallic solids can be removed from the char more easily than from the original feedstock, thus increasing the efficiency of the main

treatment step.

ABSTRACTED-PUB-NO: GB 2109400B

EQUIVALENT-ABSTRACTS:

A thermal conversion system has first and second reactors. The first pre-treats a feedstock by pyrolysis at atmospheric pressure from which a char and a liq. prod. are produced. The char is pulverised and then slurried with the liq. prod. prior to feeding to the second reactor.

Pref. the first and second reactors are of the cross-flow pyrolysis and the high pressure gasification type respectively. Also there is a methanol loop receiving gas from the second reactor and a liquor cycle in which the gaseous prod. from the first reactor is treated and mixed with water to produce the liq. product. Undesirable characteristics such as caking of the feedstock is obviated in the pretreatment pyrolysis. Also impurities such as mineral matter and metallic solids can be removed from the char more easily than from the original feedstock, thus increasing the efficiency of the main treatment step. (4pp)

TITLE-TERMS: THERMAL CONVERT SYSTEM CAKE FEEDSTOCK OBVIATE IMPURE REMOVE ENHANCE

DERWENT-CLASS: E17 H09

CPI-CODES: E10-E04E; E31-A; H09-A; H09-C;

CHEMICAL-CODES: Chemical Indexing M3 *01* Fragmentation Code H4 H401 H481 H8 M210 M211 M272 M281 M320 M416 M424 M620 M720 M903 M910 N513 N514 N515 N522 N523 Q419 Q439

Chemical Indexing M3 *02* Fragmentation Code C101 C550 C810 M411 M424 M720 M903 M910 N513 N514 N515 N522 N523 Q419 Q439

Chemical Indexing M3 *03* Fragmentation Code C106 C108 C550 C730 C800 C801 C802 C803 C805 C807 M411 M424 M720 M903 M910 N513 N514 N515 N522 N523 Q419 Q439

UNLINKED-DERWENT-REGISTRY-NUMBERS: ; 0270P ; 1423P ; 1532P

SECONDARY-ACC-NO:

CPI Secondary Accession Numbers: C1983-050760

PUB-NO: GB002109400A
DOCUMENT-IDENTIFIER: GB 2109400 A
TITLE: Thermal conversion systems
PUBN-DATE: June 2, 1983

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APPL-NO: GB08129853
APPL-DATE: October 2, 1981

PRIORITY-DATA: GB08129853A (October 2, 1981)

INT-CL (IPC): C10J003/00

EUR-CL (EPC): C10J003/66 , C07C029/152

US-CL-CURRENT: 48/197R

ABSTRACT:

Thermal conversion systems particularly suited to the production of syngas or methanol from fibrous feedstocks are provided. In order to prepare the feedstock for the major treatment in a second reactor (36), it is first subjected to pyrolysis at around atmospheric pressure in a first reactor (8) whence a char is produced. At least a part of the gaseous fraction from the first reactor (8) is fed to a liquor cycle (18) where it is mixed with water to form a liquid product. This product is in turn mixed with the char to form a slurry which is fed to the second reactor (36).

(12) UK Patent Application (19) GB (11) 2 109 400 A

(21) Application No 8129853
(22) Date of filing 2 Oct 1981
(43) Application published
2 Jun 1983
(51) INT CL³
C10J 3/00
(52) Domestic classification
C5E AN
(56) Documents cited
None
(58) Field of search
C5E
F4B
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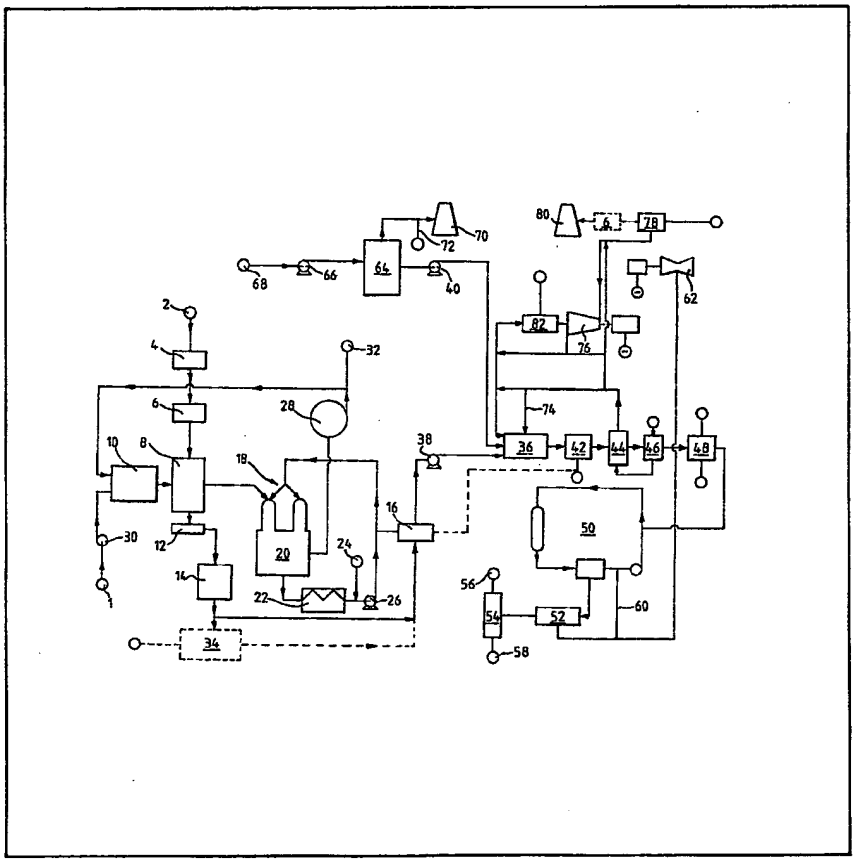
(54) **Thermal conversion systems**

(57) Thermal conversion systems particularly suited to the production of syngas or methanol from fibrous feedstocks are provided. In order to prepare the feedstock for the major treatment in a second reactor (36), it is first subjected to pyrolysis at around atmospheric pressure in a first reactor (8) whence a char is produced. At least a part of the gaseous fraction from the first reactor (8) is fed to a liquor cycle (18) where it is mixed with water to form a liquid product. This product is in turn mixed with the char to form a slurry which is fed to the second reactor (36).



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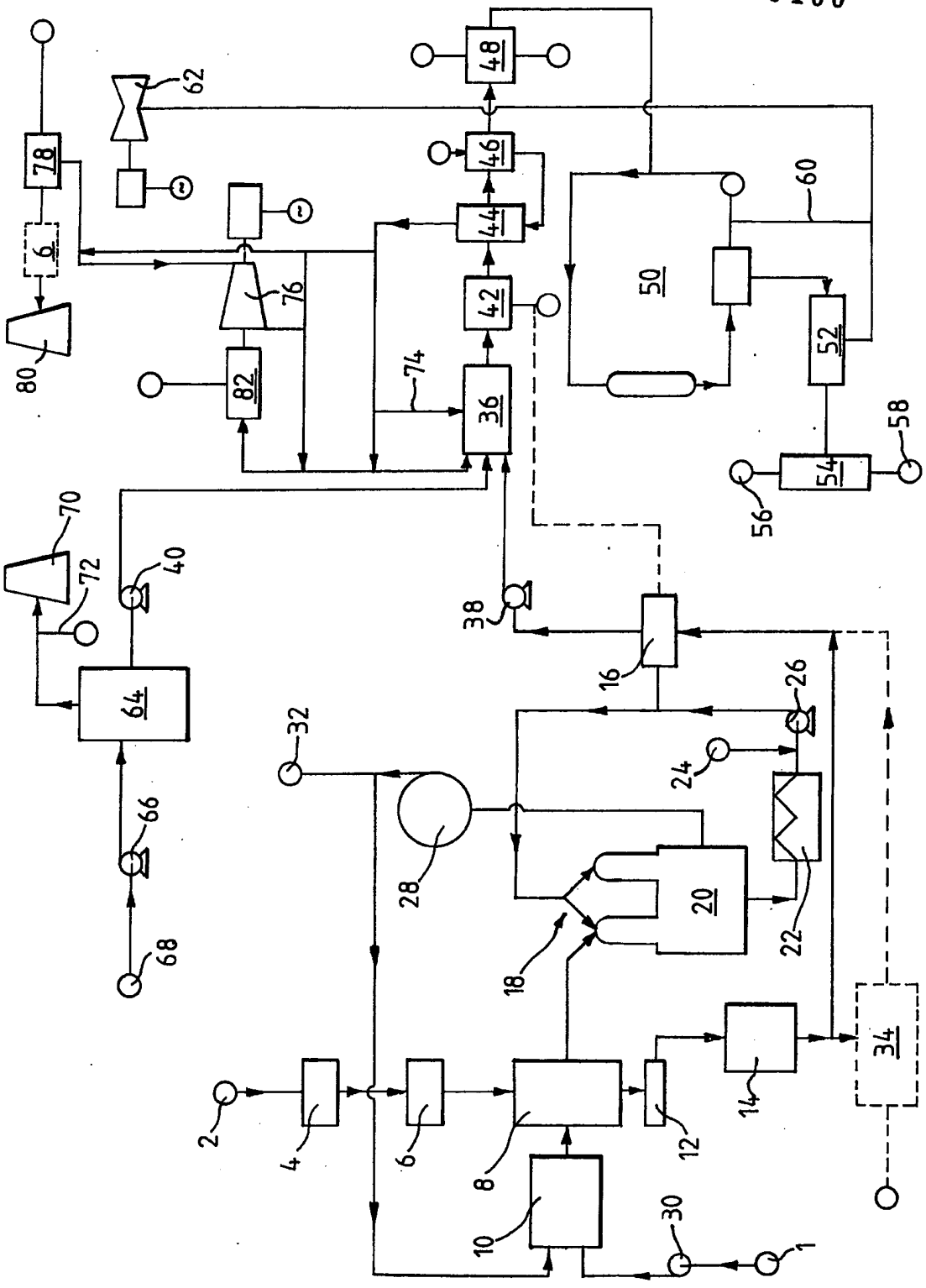
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SPECIFICATION

Integral two-stage thermal conversion system for syngas/methanol production from fibrous feedstock

The invention relates to thermal conversion systems and particularly to the production of syngas or methanol from fibrous feedstocks. The primary aim of the invention is the provision of a system in which the feedstock is better suited to treatment in a gasifier or other reactor.

Certain fuels are unsuitable for direct treatment in a reactor either alone or in a slurry or mix, particularly where the reactor operates under significant internal pressure. Making a slurry with water or an organic fluid for example is a recognized technique for feeding in a number of systems, but not for some materials. Most types of biomass and RDF for example are not suitable for such pre-treatment because of their fibrous nature. To meet this problem, the present invention contemplates a pre-treatment in which the feedstock is pyrolised at around atmospheric pressure to produce a char and liquid product, the char being then pulverized and slurried with the liquid products for feeding to a second reactor (normally pressurized). While this can result in say, 20% by weight loss of the dry feedstock, this loss is offset by a number of consequent benefits.

A primary advantage of the invention is the creation of a slurry which is considerably easier to feed to a pressurized reactor than the original feedstock. For any fuel, pre-conversion pyrolysis can be an advantage because it allows a slurry to be produced without using either hydrocarbon liquids which are expensive, or extra water which can both detract from the quality of the products and increase the oxygen requirements of the system. Also, by products with a higher value than the final product may be recovered from the pyrolysis reactor output streams.

Undesirable characteristics, such as caking of the feedstock can be obviated in the pre-treatment pyrolysis. Further, impurities such as mineral matter and metallic solids can be removed from the char more easily than from the original feedstock, thereby increasing the efficiency of the main treatment step, and reducing maintenance costs.

Pre-treatment according to the invention can be carried out at locations remote from the main treatment. This means that for dispersed fuel sources, such as crop wastes and forestry residues, low cost pyrolysis plants can be used to concentrate wastes at source, reducing transport and storage costs. Even in a single plant, lower capital and maintenance costs can be achieved in the combination of an atmospheric pyrolysis reactor and a high pressure gasification reactor than in an equivalent high-pressure system without slurry feeding.

The invention will now be described by way of example and with reference to the accompanying drawing which shows, in block diagram form, an integrated two stage thermal conversion system for syngas/methanol production from fibrous feedstock.

In the system illustrated in the drawing a wood feedstock is delivered at 2, and conveyed via a chipper 4 and a dryer 6 to a cross-flow pyrolysis reactor 8 which operates at atmospheric pressure. Heat for the reactor 8 is provided by a furnace or other hot gas source 10. The treated feedstock is discharged to a char auger 12 and char pulveriser 14, and thence fed to a slurry mixer 16. At least a part of the gaseous fraction of the reaction product from reactor 8 is fed to a liquor cycle 18 in which it is cleaned in a venturi scrubber 20, cooled in cooler 22, and circulated with make up water from source 24 by a pump 26. Liquor is extracted from the cycle 18 to the slurry mixer as required to form a pulverised char slurry for subsequent treatment. Gas is also extracted from the cycle 18 by a gas blower 28 which receives low cv gas from the scrubber 20. This gas is used to fire the furnace 10 with air from blower 30. Any additional gas is discharged at 32 for other use as appropriate.

As shown in the drawing, some of the char from the pulveriser 14 can be diverted for benefraction at 34 with low grade char if desired. Thus, the quality of the char intake to the mixer 16 can be controlled.

The slurry is pumped from the mixer 16 to a second reactor 36 by a pump 38. The reactor 36 receives oxygen from the compressor 40 and recycled product gas as described below. The second reactor 36 is a high pressure reactor producing hydrocarbon gas and char ash. The ash is removed at 42, either for discharge or recycling to the slurry mixer 16 to further control the composition of the slurry, and the gas fed to a boiler 44. Downstream of the boiler 44 the gas passes through a boiler feed water heater 46 to a gas cleaner 48 from whence water and CO_2 and impurities are discharged. The water may be recycled. The cleaned gas passes to a low pressure methanol loop 50 which discharges to a blow down vessel 52 and to a distillation column 54 from whence methanol can be extracted at 56 and the residue at 58. The residue can be used as a liquid fuel or returned to the slurry as desired. Gas is also extracted from the methanol loop by a gas purge 60 and from the blow down vessel 52 for driving a gas turbine alternator set 62.

The oxygen feed to the reactor 36 is provided from the compressor 40 supplied by an air separator unit 64. This unit 64 is in turn fed by a primary compressor 66 from an air inlet 68, separated nitrogen and other gases being exhausted and purged at 70 and 72. The recycled product gas comes from the boiler 44 either directly as shown at 74 or mixed with gas recycled through a back pressure turbo alternator set 76. A gas line from the boiler 44 fires the gas turbine (62) exhaust boiler 78 in addition to powering the back pressure turbo alternator set 76. The gas turbine exhaust can be passed through the wood dryer 6 before discharge at 80. Superfluous recycled product gas can be condensed at 82 using boiler feed water return.

It will be appreciated that in each stage a useful product gas is generated and the system can be operated without any additional fuel source apart from the primary feedstock being required. Each of the turbines can be used to generate electricity for the pumps, pulveriser and transporting systems and both the thermal and potential energy of the gas is

utilized in addition to producing methanol and liquid fuel residue.

CLAIMS

1. A thermal conversion system comprising first and second reactors, the first being adapted for pre-treating a feedstock by pyrolysis at substantially atmospheric pressure from which a char and a liquid product are produced; means for pulverizing the char; and means for slurrying the char with the liquid product for feeding to the second reactor.

2. A system according to Claim 1 wherein the second reactor is an high pressure gasification reactor.

3. A system according to Claim 1 or Claim 2 wherein the first reactor is a cross-flow pyrolysis reactor.

4. A system according to any preceding Claim including a methanol loop receiving gas from the second reactor.

5. A system according to any preceding Claim including a liquor cycle in which the gaseous product from the first reactor is treated and mixed with water to produce the liquid product.

6. A thermal conversion system substantially as described herein with reference to the accompanying drawing.

7. A method for thermally treating a fibrous feedstock comprising subjecting a feedstock to a pre-treatment by pyrolysis in a first reactor at substantially atmospheric pressure from which a char and a liquid product are produced; pulverizing the char and slurrying it with the liquid product; and subjecting the slurry to further treatment in a second reactor to generate a product gas and solid residue.

8. A method according to Claim 7 wherein the pre-treatment and main treatment are carried out at separate locations.

9. A method according to Claim 7 or Claim 8 wherein the pre-treatment produces a char and a gaseous fraction, which gaseous fraction is fed to a liquor cycle where it is mixed with water to produce the liquid product.

10. A method according to any of Claims 7 to 9 wherein a part of the pulverized char is selectively diverted for benefaction with low grade char to control the amount of char which is slurried.

11. A method according to any of Claims 7 to 10 wherein the solid residue from the second reactor is selectively recycled for mixing with the char to control the composition of the slurry.

12. A method for thermally treating a fibrous feedstock substantially as described herein with reference to the accompanying drawing.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1983.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.